

COMPOSITION OF PACIFIC SEA-FLOOR MANGANESE NODULES

by

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This collection of data on manganese nodules on the floor of the Pacific Ocean represents all the information that was available to the authors in May, 1964. It is compiled from both published references and original data. No attempt is made here to generalize or to speculate on the origin of the manganese or associated elements; further discussion of these aspects of the subject may be had by reference to the literature. For a full bibliography and detailed abstracts of the more important papers see McNely (1964).

Location of Sample Sites

Figure 1 is a plot of stations in the Pacific where manganese concretions have been either recovered or photographed. Sites where sea-bottom photographs show nodules are marked by the symbol "p". Reference to the abbreviations for the expeditions is given on the margin of the chart.

Analytical Data

In the following tables of analyses of manganese nodules from the floor of the Pacific Ocean, the 26 principal elements which have been found in the nodules are listed in the left column of Table 1, together with values where available for specific gravity (Sp. G.), loss on ignition (L.O.I.) and water (H_2O). Data on elements not on this list are compiled in Table 2. The station numbers are those of the expeditions on which the nodules were recovered. In the tables, the following abbreviations are used for the names of the expeditions:

<u>Symbol</u>	<u>Expedition Name</u>
AA	Alexander Agassiz
Acap	Acapulco
Alb	Albatross
Cap	Capricorn
Car	Carnegie
Cas	Cascadia
Chal	Challenger
Chin	Chinook
Chub	Chubasco
Cusp	Cusp
DW	Downwind
Fan	Fanfare
Hend	Henderson
Jap	Japanyon
MP	Mid-Pacific
Msn	Monsoon

<u>Symbol</u>	<u>Expedition Name</u>
Naga	Naga
NEL	Navy Electronic Laboratory
Nero	Nero
NH	North Holiday
PAS	Pelagic Area Studies
SIO	Scripps Institution of Oceanography
SOB	Southern Borderland
Trans	Transpac
Unk	Unknown Source
Val	Valdiva
Vit	Vitiaz
VS	Vermillion Sea
Wig	Wig-Wam

Within the tables, a dash (-) indicates an element looked for but not found while a blank space indicates that the element was not looked for. "Major" indicates a major constituent, a quantitative analysis of which was not possible with the method used; a "d" indicates an element that was detected but not estimated quantitatively. If any assay figure was considered questionable because of a typographical error in the original data from which this table was compiled, the assay figure is followed by a question mark.

Methods of Analysis

American Spectrographic Laboratories (ASL)

The analyses referenced "ASL" are previously unpublished data from the files of H. W. Menard. They were performed by the American Spectrographic Laboratories, San Francisco, California. The method used was an emission spectrographic technique described by Harvey (1950). An internal standard of palladium was used. The analytical results were adjusted so that the total of the assays, recorded in the original assay sheet as oxides of the elements, equaled 100 percent. This method of recording elemental contents may lead to some errors in both the absolute and relative amounts of the elements present in the nodules, as some of the elements are not present in the manganese nodules as oxides but as carbonates, sulphates, phosphates, and chlorides. The errors which would result in reducing these assays to elemental percentages, however, would be small.

Before these samples were analyzed they were heated to 1100°F. for one hour. Weighing of the sample before and after heating allowed a loss-on-ignition calculation. A number of reactions could take place in heating the nodules to 1100°F. which could affect the relative values of the metal weight percentages. One probable reaction, in addition to driving off H_2O and CO_2 is the reduction of Fe_2O_3 to Fe_3O_4 . Although such reactions might not go to completion at 1100°F., enough oxygen may be driven off to affect the assays for certain metals. Consequently, ratios of metal weight percentages calculated from these data will not necessarily correlate

with those calculated from other analytical data. A comparison of ASL assays with wet chemical techniques may be found in Goldberg and Arrhenius (1958).

Dietz (D)

The analyses referenced by "D" are taken from a published report by Dietz (1955). They were performed by the Salt Lake City Branch of the U. S. Bureau of Mines under the auspices of J. Bruce Clemmer on samples supplied by Robert F. Dietz. These assays were wet chemical assays. The analyses are recorded on a total-weight-of-sample basis.

Goldberg (G)

The assays referenced by "G" were taken from a published report (Goldberg, 1954). The colorimetric methods used by Goldberg are listed in the following table:

METHODS OF SPECTROPHOTOMETRIC ASSAY

Element	Method	Modification	Reference
Fe	Formation of alpha-alpha depyridyl complex		Snell & Snell 1949, p.318
Ni	Formation of dimethyl glyoxime complex		Sandell, 1950 p.473
Mn	Persulfate oxidation to permanganate		Nydaahl, 1949
Al	Formation of lake with aluminon		
Cu	Formation of diethyldithio-carbonate complex		Sandell, 1950 p. 147
Ti	Formation of complex after addition of hydrogen peroxide		Sandell, 1950 p. 572
Zr	Formation of lake with sodium alizarinate	Initial scavenging with cupferron in 10% HCL solution to remove Mn interference, followed by an ammonium hydroxide precipitation to remove Cu, which interferes by forming a yellow color with thiglycolic acid.	Sandell, 1950 p.641
P	Formation of molybdenum blue complex		Snell & Snell, 1949, p. 639
Co	Formation of nitrose R complex after separation on an alumina column.	Microadaptation of a microtechnique	Dean, 1952

Hewett (H)

The analyses referenced by "H" are previously unpublished data from the files of D. F. Hewett of the U. S. Geological Survey in Menlo Park, California. They were performed in the laboratories of the U. S. Geological Survey by emission spectographic methods. The data listed, like the ASL analyses, are normalized to a dry-weight basis.

Murray and Renard (M&R)

The analyses on the Challenger samples are classical wet chemical assays and are taken from a table listed on Page 370 of Volume 5 of the Challenger Reports (Murray and Renard, 1891). These assays are reduced from the mineralogical compositions as listed in that table to elemental compositions in our tables. The constituents not included in our tables are nitrogen, sulphur, oxygen, and carbon. The compositions listed in the Challenger table were made to total 100 percent even though they did not include quantitative determination of minor elements such as copper, nickel, or cobalt. Assays for copper, nickel, and cobalt were most often recorded by such terms as an abundant trace, a good trace, trace, or small trace. By comparison with known assays for nickel, cobalt, and copper on some of these samples it was possible to construct a table which shows a rough correlation between the assay for these three metals as described in the Challenger Reports and the weight percent of a metal. This table is listed below. As a result, many of the copper, nickel, and cobalt assays are inferred in our table. Such inferred assays are prefaced by a " ~ " mark.

Correlation Between Assays as Described in the Challenger Reports with the Weight Percent of Copper, Nickel, and Cobalt.

Assay as Described in Challenger Reports	Weight Percent of the Metal (Copper, Nickel, and Cobalt)
small trace	0.1 to 0.3
trace	0.3 to 0.6
good trace	0.6 to 1.0
abundant trace	1.0 to 1.8

The assays referenced "M&R" are not normalized to a dry weight basis but are listed on a total-weight-of-sample basis. The water content in the Challenger analyses was determined by drying a sample of the nodules at 100°C.

Mero (M)

Analyses referenced "M" are from a report by Mero (1961). The method used was an x-ray fluorescence technique described by Gordon, Mero and Shaffer (1961). According to Mero (1961, p. 68, 70):

"The equipment used was a General Electric XRD-5 with a tungsten tube. Lithium fluoride was used as the diffraction element in assaying for all elements above calcium in the atomic table and EDDT was used in conjunction with a helium path for all elements with an atomic number less than calcium. Flow counters were used in conjunction with a pulse height analyzer to eliminate x-ray lines of different but integral

orders in gathering count data. The stability of the equipment was found to be excellent.

"The equipment was calibrated by the use of standard ores made from pure oxide forms of the elements in the nodules and carefully mixed in proportion to the amounts of these elements generally found in the manganese nodules. Chemically analyzed standards of the nodules themselves were also used. As a final check, a known amount of the element in question was added to selected samples of the nodules and careful counts were taken on these samples before and after the addition of the extra amount of the element.

"The method involved the determination and subsequent use of absorption and activation factors for the lines of the various elements. All the absorption and activation factors were carefully determined using the standard ores. When applied to chemically analyzed samples of the nodules these methods yielded an accuracy to at least three significant figures, or certainly within the limits of the accuracy of the chemical analyses performed on our standards."

10

References in Text of Table

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5. Gordon, G. M., Mero, J. L. and Shaffer, L. E., 1961, Analysis of ores by x-ray fluorescence spectrography: in *Mining Research*, Pergamon Press, p. 321-330.
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7. Mero, J. L., 1961, Manganese nodules on the ocean floor: Report to the D. C. Jackling Fellowship Committee, August 6, 1961.
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9. Nydahl, F., 1949, The determination of manganese by the peroxidisulphate method: *Anal. chimica Acta*, v. 3, p. 144-154.
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11. Snell, F. D., and Snell, C. T., 1949, Colorimetric methods of analysis: *New York, D. van Nostrand Co.*

Table 1

Station	Acap 10	Acap 11
Latitude	N11-38	N10-53
Longitude	W125-41	W105-07
Depth (m)	4000	3275
Assoc Sed	Red Clay	-
Sampler	Core	Core
Nod. Size (cm)	0.1	1
Anal. Ref.	M-56	M-55
Be		
B		
Na		
Mg		
Al	3.6	6.6
Si	12.1	13.3
P		
K	0.65	0.65
Ca	12.6	2.97
Sc		
Ti	0.22	0.14
V		
Cr		
Mn	1.7	3.4
Fe	6.3	15.5
Co	0.013	0.03
Ni	0.045	0.036
Cu	0.076	0.078
Zn	0.057	0.019
Ga		
Sr	0.12	0.17
Y		
Zr		
Mo		
Ba		
La		
Yb		
Pb	0.082	0.090
Sp. G		
L.O.I.		
H ₂ O	20.0	14.0

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2

Table 1 (Continued)

Station	Alb 2		Alb 13	
Latitude	N 28-23		N 9-57	
Longitude	W 126-57		W 137-47	
Depth (m)	4340		4930	
Assoc Sed	Red Clay		Red Clay	
Sampler	Trawl		Trawl	
Nod. Size (cm)	1 - 15		10 - 15	
Anal. Ref.	M-25	ASL-13	H-493*	M-60
Be			0.0002	
B		0.014	0.007	
Na		3.1	3.	
Mg		1.7	1.5	
Al		2.7	3.	
Si		7.5	7.	
P	0.128			0.052
K	1.83	1.1	1.5	0.79
Ca	0.75	1.8	3.	1.47
Sc		0.0008	0.0015	
Ti	0.43	0.43	0.7	0.44
V		0.42	0.03	
Cr		0.0006	0.0015	
Mn	10.4	32.	Major	29.8
Fe	10.6	5.3	7.	4.8
Co	0.19	0.18	0.3	0.20
Ni	0.67	2.0	1.5	1.36
Cu	0.44	1.4	1.5	1.20
Zn	0.050	0.04	0.07	0.12
Ga		0.0007		
Sr	0.062	0.059	0.15	0.070
Y		0.011	0.015	
Zr		0.035	0.03	
Mo	0.032	0.07	0.07	0.054
Ba	0.42	0.28	0.15	0.61
La			0.015	
Yb		0.0018	0.0015	
Pb	0.13	0.051	0.07	0.055
Sp.G	2.47		2.53	
L.O.I.		22.	22.	
H ₂ O	14.3		16.2	

*See also Table 2, page 37

Table 1 (Continued)

3

Station	Alb-31			Alb-173		
Latitude	S 12-20			S 18-55		
Longitude	W 144-15			W 146-32		
Depth (m)	4840			4460		
Assoc Sed Sampler	Red Clay Trawl			Red Clay Trawl		
Nod. Size (cm)	1.3			4 x 10 x 10		
Anal. Ref.	ASL-52*	ASL-82	M-77	ASL-12	H-49*	M-74
Be					0.000	
B	0.016	0.022		0.04	0.015	
Na	3.1	3.1		2.5	1.5	
Mg	1.9	2.2		1.4	1.5	
Al	4.9	4.6	3.7	3.3	3.	3.4
Si	14.0	8.4	6.8	7.9	7.	6.3
P						0.213
K	2.3	1.5	0.35	0.7	1.5	0.50
Ca	1.4	1.5	2.0	2.6	3.	2.08
Sc	0.0020			0.0009	0.001	
Ti	0.6	0.6	0.5	1.6	1.5	1.20
V	0.037	0.043		0.05	0.07	
Cr	0.0010	0.0009		0.0031	0.003	
Mn	15.8	24.	19.3	16.4	Major	15.0
Fe	10.5	9.8	7.9	22.4	Major	16.1
Co	0.18	0.18	0.15	0.49	0.3	0.50
Ni	0.9	1.0	0.81	0.34	0.3	0.23
Cu	0.52	0.76	0.61	0.20	0.15	0.17
Zn		0.04	0.03	0.04	<0.05	0.057
Ga	0.0014	0.0007				
Sr	0.053	0.61	0.05	0.08	0.15	0.12
Y	0.019	0.012		0.017	0.03	
Zr	0.048	0.052		0.07	0.07	
Mo	0.026	0.042	0.034	0.027	0.03	0.031
Ba	0.11	0.14	0.11	0.13	0.15	0.54
La	0.017			0.013	0.03	
Yb	0.0026	0.0018		0.0035	0.003	
Pb	0.035	0.04	0.032	0.10	0.15	0.12
Sp. G						
L.O.I.	19.	19.5	19.5	22.5		22.5
H ₂ O						17.7

#See also Table 2, page 37

Table 1 (Continued)

Station	Alb 4622	Alb 4656	Alb 4658
Latitude	N 6-21	S 6-55	S 8-30
Longitude	W 81-44	W 83-34	W 85-36
Depth (m)	1061	4060	4340
Assoc Sed.	T. Sed.	Gr. mud	Gr. mud-Rad.O
Sampler	Dredge	Trawl	Trawl
Nod. Size (cm)	3x4x1½	4x7x9	8-13
Anal. Ref.	M-64	ASL-8	M-72
		M-71	
Be			
B		0.018	
Na		3.2	
Mg		1.6	
Al	2.3	2.1	4.4
Si	7.2	10.7	20.5
P	0.253		0.020
K	0.40	1.2	1.54
Ca	1.70	1.0	0.69
Sc			1.24
Ti	0.47	0.11	0.11
V		0.037	
Cr		0.0017	0.06
Mn	15.1	31.	9.6
Fe	17.7	5.7	7.71
Co	0.36	0.014	0.027
Ni	0.25	0.25	0.11
Cu	0.05	0.11	0.19
Zn	0.043	0.04	0.067
Ga			42.3
Sr	0.15	0.042	0.043
Y			0.039
Zr		0.009	
Mo	0.037	0.030	0.022
Ba	0.45	0.29	0.42
La			0.26
Yb			
Pb	0.082	0.017	0.078
Sp. G.			0.022
L.O.I.	26.	18.5	18.5
H ₂ O	20.1		11.9
			13.9

ALB 15945009

5

Table 1 (Continued)

Station	Alb 4660			Alb 4662			
Latitude	S 9-56			S 11-14			
Longitude	W 87-30			W 89-35			
Depth (m)	4440			4460			
Assoc Sed	Br. mud				Rad. ooze		
Sampler	Trawl				-		
Nod. Size (cm)	4-18				1-10		
Anal. Ref.	ASL-11	ASL-93	M-70	ASL-17	ASL-94	H-495*	M-83
Be							
B	0.021	0.021		0.023	0.028	0.015	
Na	3.1	2.8		2.2	2.6	3.	
Mg	1.6	1.7		1.8	1.8	3.	
Al	2.0	2.2	2.2	2.8	2.4	1.5	2.4
Si	5.1	5.6	4.4	7.0	7.	7.	5.7
P			0.041				
K	0.6		0.98	0.4	0.6	1.5	0.71
Ca	1.8	1.8	1.07	1.8	1.9	3.	1.40
Sc		0.0007		0.0009		0.0007	
Ti	0.26	0.29	0.10	0.41	0.32	0.3	0.35
V	0.044	0.054		0.055	0.050	0.03	
Cr				0.0008	0.0009	0.0015	
Mn	35.4	34.1	39.1	29.1	31.	Major	25.1
Fe	8.4	9.1	1.98	11.9	10.5	Major	8.88
Co	0.07	0.09	0.030	0.11	0.11	0.15	0.13
Ni	1.5	1.7	0.57	1.5	1.2	1.5	1.11
Cu	0.49	0.63	0.30	0.72	0.67	0.7	0.78
Zn	0.05	0.05	0.074		0.05	0.07	0.095
Ga	0.0007				0.0007		
Sr	0.055	0.074	0.048	0.058	0.055	0.15	0.092
Y	0.0095	0.0095		0.015	0.0095	0.015	
Zr	0.044	0.043		0.067	0.053	0.07	
Mo	0.062	0.07	0.041	0.044	0.041	0.03	0.033
Ba	0.17	0.20	0.73	0.29	0.30	0.3	0.59
La							
Yb	0.0026	0.0018		0.0031	0.0018	0.0015	
Pb	0.042	0.067	0.004	0.032	0.078	0.03	0.060
Sp. G							
L.O.I.	25.	23.5	23.5	23.5	23.		
H ₂ O			17.9			23.5	16.3

#See also Table 2, page 37

ALB 15945009

6

Table 1 (Continued)

Station	Alb 4676			Alb 4681	
Latitude	S 14-29			S 18-47	
Longitude	W 81-24			W 89-26	
Depth (m)	4970			4390	
Assoc Sed	Br. ooze			Br. clay	
Sampler	Trawl			Trawl	
Nod. Size (cm)	6-7			2.5	
Anal. Ref.	ASL-15	ASL-89	M-85	ASL-16	M-84
Be					
B	0.021	0.015		0.026	
Na	2.9	2.4		2.5	
Mg	1.4	1.5		1.9	
Al	2.9	3.0	3.8	3.1	2.6
Si	7.9	9.0	8.0	6.1	4.7
P			0.377		0.040
K	0.6	0.7	0.73	0.5	0.65
Ca	1.7	1.4	1.77	2.1	1.72
Sc				0.0010	
Ti	0.20	0.24	0.21	0.29	0.34
V	0.06	0.052		0.06	
Cr	0.0010	0.0008			
Mn	29.7	29.1	23.4	27.8	26.6
Fe	9.8	8.4	7.75	12.6	8.80
Co	0.039	0.038	0.053	0.18	0.24
Ni	1.3	1.0	1.25	1.7	1.26
Cu	0.75	0.60	0.80	0.9	0.76
Zn		0.04	0.11	0.07	0.14
Ga				0.0007	
Sr	0.036	0.055	0.064	0.065	0.077
Y	0.0059	0.0095		0.011	
Zr	0.036	0.038		0.044	
Mo	0.09	0.07	0.058	0.058	0.047
Ba	0.14	0.18	0.27	0.12	0.41
La					
Yb	0.0018	0.0013		0.0026	
Pb	0.036	0.027	0.049	0.12	0.082
Sp. G					
L.O.I.	22.	22.	22.	26.5	26.5
H ₂ O			18.3		18.6

MARCH 6 1969

7

Table 1 (Continued)

Station	Alb 4685			Alb 4701			
Latitude	S 21-36			S 19-12			
Longitude	W 94-56			W 102-24			
Depth (m)	4040			4150			
Assoc Sed	Br. clay			Choc. clay			
Sampler	Trawl			Trawl			
Nod. Size (cm)	2			0.5 x 2 x 2			
Anal. Ref.	ASL-9*	ASL-92	M-88	ASL-51	ASL-83	ASL-96	M-82
Be							
B	0.20	0.016		0.027	0.017	0.03	
Na	4.4	3.8		3.1	3.0	3.0	
Mg	1.1	1.3		1.9	2.2	2.1	
Al	4.4	5.0	4.4	2.5	4.9	4.2	2.0
Si	15.0	12.1	9.2	10.3	11.2	11.7	8.1
P			0.132				
K	2.9	2.5	1.23	1.7	1.2	0.5	1.4
Ca	1.4	1.9	1.40	1.3	1.6	2.1	1.0
Sc	0.0009	0.0012			0.0013		
Ti	0.49	0.7	0.72	0.21	0.49	0.52	0.17
V	0.029	0.035		0.052	0.041	0.039	
Cr	0.0008			0.0008	0.0014	0.0014	
Mn	12.6	13.3	15.5	21.5	19.6	19.6	17.2
Fe	11.9	15.4	10.6	13.3	11.2	10.5	11.6
Co	0.14	0.14	0.18	0.20	0.11	0.11	0.16
Ni	0.39	0.42	1.09	1.9	1.2	1.3	1.52
Cu	0.22	0.26	0.62	0.74	0.58	0.64	0.59
Zn			0.10			0.04	
Ga				0.0007		0.0007	
Sr	0.062	0.09	0.066	0.051	0.061	0.047	0.041
Y	0.016	0.020		0.011	0.011	0.0059	
Zr	0.058	0.068		0.050	0.058	0.041	
Mo	0.027	0.022	0.033	0.054	0.046	0.039	0.043
Ba	0.10	0.19	0.32	0.28	0.14	0.20	0.22
La							
Yb	0.0031	0.0018		0.0026	0.0018	0.0013	
Pb	0.066	0.054	0.082	0.065	0.031	0.082	0.052
Sp. G							
L.O.I.	23.5	21.5		20.	18.5	19.	20.
H ₂ O			19.0				

*See also Table 2, page 37

MARCH 9 1960

8

Table 1 (Continued)

Station	Alb 4711			Alb 4721		Cap 50B
Latitude	S 7-48			S 8-08		N 14-55
Longitude	W 94-06			W 104-11		W124-12
Depth (m)	4100			3820		4720
Assoc Sed	Calc. ooze			Calc. ooze		Red Clay
Sampler	Trawl			-		Core
Nod. Size (cm)	9-15			2-8		-
Anal. Ref.	ASL-18	ASL-91	M-69	ASL-10*	M-68	M-49
Be						
B	0.013	0.016		0.05		
Na	4.0	3.2		2.3		
Mg	1.8	1.4		1.6		
Al	2.0	1.5	1.8	1.2	1.3	3.2
Si	3.1	3.3	3.7	10.3	4.7	7.6
P			0.101		0.113	
K	0.5	0.5	0.62	1.0	0.49	0.82
Ca	1.9	1.8	1.74	1.1	1.39	1.19
Sc						
Ti	0.15	0.16	0.20	0.11	0.14	0.33
V	0.052	0.051		0.043		
Cr	0.0012					
Mn	37.9	41.1	36.5	17.1	23.0	22.4
Fe	5.5	4.5	3.68	23.8	14.3	7.6
Co	0.038	0.031	0.050	0.041	0.55	0.39
Ni	2.0	1.6	1.10	0.9	1.00	1.15
Cu	0.64	0.65	0.57	0.51	0.70	1.25
Zn	0.04	0.05	0.13	0.04	0.11	0.11
Ga		0.0007		0.0007		
Sr	0.063	0.05	0.055	0.09	0.082	0.074
Y	0.008	0.0095		0.007		
Zr	0.038	0.046		0.072		
Mo	0.07	0.054	0.038	0.025	0.032	0.052
Ba	0.30	0.19	0.59	0.13	0.50	0.42
La						
Yb	0.0026	0.0022		0.0026		
Pb	0.03	0.026	0.011	0.019	0.050	0.11
Sp. G						
L.O.I.	21.5	21.5	21.5	26.5	26.5	
H ₂ O			16.2		17.8	18.3

*See also Table 2, page 37

Table 1 (Continued)

Station	Car-46		Car 78		Cas D-5		
Latitude	S 17-36		N 16-15		N 42-45		
Longitude	W 141-55		W 137-06		W 128-03		
Depth (m)	2132		4553		2520		
Assoc Sed Sampler	Calc. Ooze		R.C. Snapper		Volc. Rock Dredge		
Nod. Size (cm)	-		1		-		
Anal. Ref.	ASL-49	M-78	ASL-47	M-43	ASL-35	ASL-90	M-107
Be							
B	0.04		0.027		0.06	0.04	
Na	2.2		2.7		2.1	2.0	
Mg	1.2		2.0		1.0	1.1	
Al	1.6	1.1	3.9	2.8	1.8	2.0	1.5
Si	4.5	3.2	8.4	13.7	13.5	13.	9.4
P							
K	0.5	0.35	0.4	2.0	0.5	0.3	0.2
Ca	2.8	2.0	1.7	0.8	1.8	2.1	1.5
Sc	0.0014				0.0013	0.0014	
Ti	1.4	1.0	0.31	0.8	0.41	0.57	0.42
V	0.08		0.048		0.046	0.06	
Cr	0.0006		0.0008		0.0014	0.0018	
Mn	22.8	16.0	26.5	10.0	15.2	17.5	12.8
Fe	19.6	16.2	9.8	8.9	21.7	21.7	15.7
Co	0.7	0.49	0.11	0.20	0.17	0.16	0.12
Ni	0.48	0.34	1.6	0.46	0.16	0.15	0.11
Cu	0.13	0.09	0.72	0.40	0.061	0.048	0.035
Zn	0.05	0.035	0.04	0.04	0.04	0.04	0.03
Ga							
Sr	0.11	0.077	0.051	0.07	0.13	0.12	0.09
Y	0.041		0.013		0.017	0.034	
Zr	0.10		0.038		0.056	0.012	
Mo	0.05	0.035	0.064	0.015	0.050	0.059	0.043
Ba	0.13	0.091	0.09	0.095	0.12	0.13	0.095
La	0.021				0.011	0.026	
Yb	0.0053		0.0035		0.0035	0.0026	
Pb	0.078	0.07	0.052	0.11	0.10	0.071	0.052
Sp. G							
L.O.I.	30.	30.	21.	21.	27.5	27.	27.
H ₂ O							

Table 1 (Continued)

Station	Chal 248		Chal 252	
Latitude	N 37-41		N 37-52	
Longitude	W 177-04		W 160-17	
Depth (m)	5310		5010	
Assoc Sed Sampler	Red Clay Trawl		Red Clay Trawl	
Nod. Size (cm)	7		7	
Anal. Ref.	M-6	M-7	M&R-103	M&R-104
				M&R-105
Be				
B				
Na				
Mg			0.69	0.77
Al	3.9	2.2	3.10	3.54
Si	11.2	8.8	12.97	9.95
P	0.14	0.116		
K	1.22	1.28		
Ca	1.24	0.99	1.77	1.96
Sc				
Ti	0.34	0.59		
V				
Cr				
Mn	16.5	19.9	18.0	16.05
Fe	10.3	12.4	14.32	13.10
Co	0.090	0.13		0.25
Ni	0.28	0.40	~1.	0.4
Cu	0.43	0.26	~0.2	0.5
Zn	0.38	0.31		~0.5
Ga				
Sr	0.10	0.057		
Y				
Zr				
Mo	0.027	0.037		
Ba	0.36	0.34		
La				
Yb				
Pb	0.094	0.15		
Sp. G				
L.O.I.				
H ₂ O	17.0	17.0	10.60	20.80
				15.2

Table 1 (Continued)

0 0 9
11

Station	Chal 253	Chal 256	Chal 264
Latitude	N 38-09	N 30-22	N 14-19
Longitude	W 156-25	W 56-154	W 152-37
Depth (m)	5710	5400	5490
Assoc Sed	Red Clay	Red Clay	Red Clay
Sampler	Dredge	Dredge	Trawl
Nod. Size (cm)	6x20x31	3	-
Anal. Ref.	M&R 107	M&R 108	M&R 109
Be			
B			
Na			
Mg	0.44	1.33	1.18
Al	3.44	1.96	1.67
Si	10.89	9.32	13.24
P	0.09		
K			
Ca	1.98	1.45	1.54
Sc			
Ti			
V			
Cr			
Mn	16.6	25.0	18.4
Fe	15.48	13.7	16.15
Co	~0.5	~0.5	~0.5
Ni	~1.	~1.	~1.
Cu	~1.	~1.5	~1.5
Zn			
Ga			
Sr			
Y			
Zr			
Mo			
Ba			
La			
Yb			
Pb			
Sp. G			
L.O.I.			
H ₂ O	12.10	11.30	8.9

Table 1 (Continued)

Station	Chal 274		
Anal. Ref.	M&R-110	M&R-111	M&R-112
Be			
B			
Na			
Mg	1.51	0.68	1.28
Al	0.85	0.45	0.32
Si	6.32	5.82	5.31
P	0.27	0.17	0.07
K			
Ca	2.46	2.38	2.11
Sc			
Ti			
V			
Cr			
Mn	32.5	33.04	35.27
Fe	6.3	9.04	7.37
Co			
Ni	~1.	~1.	~1.
Cu	0.79	0.79	0.79
Zn			
Ga			
Sr			
Y			
Zr			
Mo			
Ba			
La			
Yb			
Pb			
Sp. G			
L.O.I.			
H ₂ O	12.6	12.5	11.4

MCC 15995009

13

Table 1 (Continued)

Station	Chal 276				
Latitude	S 13-28				
Longitude	W 149-30				
Depth (m)	4310				
Assoc. Sed.	Red Clay				
Sampler	Trawler				
Nod. Size (cm)	2				
Anal. Ref.	M-73	M&R-113	M&R-114	M&R-115	W(M344)
Be					
B					
Na					
Mg		0.74	0.62	0.74	
Al	2.8	3.34	1.64	5.67	
Si	5.8	7.27	6.85	21.60	
P	0.127				
K	0.58				
Ca	1.87	2.79	2.52	1.81	
Sc					
Ti	0.88				
V					
Cr					
Mn	21.6	7.22	9.38	1.21	
Fe	12.0	29.35	32.4	16.08	
Co	0.35	~.5	~.5		0.372
Ni	0.77	1.43	~.5		0.422
Cu	0.35	~1.	~1.	~.5	0.216
Zn	0.071				
Ga					
Sr	0.11				
Y					
Zr					
Mo	0.043				
Ba	0.25				
La					
Yb					
Pb	0.13				
Sp. G					
L.O.I.					
H ₂ O	23.6	16.3	14.4	14.10	

MCG 1 5 9 2 5 0 0 9

14

Table 1 (Continued)

Station	Chal 281		
Latitude	S 22-21		
Longitude	W 150-17		
Depth (m)	4370		
Assoc. Sed.	Red Clay		
Sampler	Trawl		
Nod. Size (cm)	1		
Anal. Ref.	M&R-117	M&R-118	M&R-119
Be			
B			
Na			
Mg	0.53	0.62	0.54
Al	1.72	2.48	2.56
Si	10.6	11.38	20.05
P			
K			
Ca	1.81	1.92	3.13
Sc			
Ti			
V			
Cr			
Mn	14.08	12.6	4.12
Fe	21.2	23.8	23.0
Co	~0.5		~0.5
Ni	~1.		~0.5
Cu	~1.	~1.	~0.5
Zn			
Ga			
Sr			
Y			
Zr			
Mo			
Ba			
La			
Yb			
Pb			
Sp. G			
L.O.I.			
H ₂ O	16.0	11.0	5.66

Table 1 (Continued)

MCC 1 5 0 4 5 0 0 9

15

Station	Chal 285						
Latitude	S 32-36						
Longitude	W 137-43						
Depth (m)	4340						
Assoc Sed	Red Clay						
Sampler	Trawl						
Nod. Size (cm)	3						
Anal. Ref.	M-92	M&R-120	M&R-121	M&R-123	M&R-124	M&R-125a	M&R p.422*
Be							
B							
Na							1.34
Mg		0.39	0.42	0.41	0.49	0.05	1.41
Al	2.9	2.35	5.95	7.52	4.97	6.07	2.91
Si	6.3	7.84	12.98	12.16	19.0	10.4	6.25
P	0.057		1.43	0.52		0.18	0.057
K	0.21						0.21
Ca	1.65	1.24	4.72	2.65	1.26	2.95	1.65
Sc							
Ti	0.078						0.078
V							0.056
Cr							
Mn	16.7	23.1	15.61	13.95	5.4	14.05	16.65
Fe	10.1	17.7	9.68	12.24	19.95	9.92	10.05
Co	0.22						0.22
Ni	0.77						0.77
Cu	0.30	~1.		~.5	~.5	~1.	0.30
Zn	0.08						0.08
Ga							
Sr	0.017						0.017
Y							
Zr							
Mo	0.067						0.067
Ba	0.11						0.11
La							
Yb							
Pb	0.047						
Sp. G							
L.O.I.							
H ₂ O	29.95	12.9	9.25	13.0	8.23	23.4	29.65

*See also Table 2, page 37

Table 1 (Continued)

Report No. 009

16

Station	Chal 286			Chal 289	
Latitude Longitude Depth (m)	S 33-29 W 133-22 4270			S 39-41 W 131-23 4660	
Assoc. Sed Sampler Nod. Size (cm)	Red Clay Trawl 0.5			Red Clay Trawl 6	
Anal. Ref.	M&R-126	M&R-127	M&R-128	M-95	M&R-129
Be					
B					
Na					
Mg	0.48	0.38	1.07		0.70
Al	2.33	2.07	1.49	3.2	2.20
Si	12.18	13.28	9.35	5.5	10.05
P	0.14	0.14		0.08	0.08
K				0.64	
Ca	2.88	1.84	2.55	1.97	2.12
Sc					
Ti				0.88	
V					
Cr					
Mn	17.32	14.4	24.1	20.7	20.25
Fe	17.63	16.85	12.5	12.0	14.68
Co	~0.5	~0.5	~0.5	0.31	0.25
Ni	~1.	~1.	~1.	0.82	
Cu	~1.	~1.	~1.	0.41	0.31
Zn				0.083	
Ga					
Sr				0.10	
Y					
Zr					
Mo				0.038	
Ba					0.44
La					
Yb					
Pb				0.11	
Sp.G					
L.O.I.					
H ₂ O	8.7	15.5	11.4	20.8	13.8

Table 1 (Continued)

1992-1993-009

17

Station	Chal 293	Chal 297
Latitude	S 39-04	S 37-29
Longitude	W 105-05	W 83-07
Depth (m)	3710	3250
Assoc Sed Sampler	Calc. ooze	Calc. ooze
Nod. Size (cm)	Trawl	Trawl
Anal. Ref.	M&R-130	M&R-131
Be		
B		
Na		
Mg	1.20	1.37
Al	1.70	0.53
Si	7.81	6.9
P	0.14	
K		
Ca	2.73	3.24
Sc		
Ti		
V		
Cr		
Mn	23.8	19.43
Fe	14.60	20.8
Co		~ 0.2
Ni	~ 1.	~ 0.2
Cu	~ 1.	~ 0.2
Zn		
Ga		
Sr		
Y		
Zr		
Mo		
Ba		
La		
Yb		
Pb		
Sp.G		
L.O.I.		
H ₂ O	11.2	11.3

M A R C H 1 0 0 9

18

Table 1 (Continued)

Station	Chal 299				
Latitude	S 33-31				
Longitude	W 74-43				
Depth (m)	3960				
Assoc Sed Sampler Nod. Size (cm)	Blue mud Trawl 4				
Anal. Ref.	ASL-85	M-99	M&R-132	M&R-133	M&R-134
Be					
B	0.007				
Na	4.0				
Mg	1.7		0.62	1.38	0.85
Al	3.0	2.5	1.59	1.53	1.27
Si	7.0	5.7	6.60	8.14	5.18
P					
K	0.7	0.6			
Ca	1.6	1.3	2.75	1.57	1.51
Sc					
Ti	0.17	0.14			
V	0.036				
Cr					
Mn	35.3	29.0	35.2	29.6	40.0
Fe	3.1	2.5	4.74	10.28	4.52
Co	0.01	0.008			
Ni	0.18	0.15	~.2	~.2	~.2
Cu	0.18	0.15	~.5	~.5	~.5
Zn	0.08	0.07			
Ga					
Sr	0.024	0.02			
Y					
Zr	0.006				
Mo	0.057	0.047			
Ba	0.25	0.20			
La					
Yb					
Pb	0.019	0.016			
Sp. G					
L.O.I	18.	18.			
H ₂ O		11.8	11.8	10.0	10.4

ECC 14945009

19

Table 1 (Continued)

20

Station	Chal 302			Chin 16	Chub 1	Chub 2	
Anal. Ref.	ASL-87	M-104	M&R-135	ASL-56*	M-50	ASL-58	M-48
Be							
B	0.05			0.04		0.018	
Na	1.8			2.1		2.2	
Mg	1.3		1.07	1.4		1.9	
Al	2.1	1.5	0.61	2.7	3.1	3.0	3.4
Si	7.5	5.5	7.00	13.1	6.8	7.0	7.4
P							
K	0.3	0.2		0.7	0.74	0.8	0.88
Ca	2.3	1.7	2.29	1.4	1.34	1.4	1.39
Sc	0.0012	0.4		0.0014		0.0014	
Ti	0.6			0.7	0.52	0.37	0.44
V	0.08			0.029		0.07	
Cr	0.0008			0.0011		0.0010	
Mn	17.7	12.9	14.1	14.5	22.4	32.9	23.8
Fe	26.6	19.4	28.6	14.7	9.5	7.0	7.3
Co	0.11	0.08		0.39	0.40	0.25	0.27
Ni	0.24	0.18	~.2	0.50	1.16	1.7	1.22
Cu	0.15	0.11	~.2	0.50	0.87	1.2	1.05
Zn	0.05	0.04			0.10	0.04	0.14
Ga				0.0007		0.0007	
Sr	0.16	0.12		0.08	0.090	0.051	0.078
Y	0.027			0.0055		0.004	
Zr	0.10			0.10		0.041	
Mo	0.055	0.04		0.01	0.052	0.09	0.049
Ba	0.22	0.16		0.18	0.70	0.28	0.52
La	0.015				0.14		0.082
Yb	0.0026			0.0022		0.0026	
Pb	0.043	0.031		0.23		0.062	
Sp.G							
L.O.I.	27.	27.	11.4	21.		25.0	
H ₂ O					19.7		17.9

*See also Table 2, page 37

Table 1 (Continued)

009

Station	Chub 3		Chub 5		Chub 9
Anal. Ref.	M-47	M-121	ASL-59	M-46	M-117
Be					
B			0.012		
Na			2.6		
Mg			2.0		
Al	2.8	2.5	4.6	4.0	2.8
Si	5.9	5.4	11.2	9.7	8.1
P					
K	0.69	0.64	1.4	0.98	0.92
Ca	1.42	1.46	0.9	1.18	1.75
Sc					
Ti	0.74	0.67	0.29	0.38	0.26
V			0.06		
Cr			0.0012		
Mn	22.2	24.0	27.8	22.2	18.9
Fe	9.7	8.3	2.4	6.3	10.0
Co	0.38	0.34	0.10	0.32	0.36
Ni	1.00	1.23	0.9	1.06	1.06
Cu	0.82	0.95	1.0	1.06	1.06
Zn	0.081	0.093	0.04	0.088	0.098
Ga			0.003		
Sr	0.096	0.097	0.099	0.056	0.087
Y			0.006		
Zr			0.024		
Mo	0.054	0.056	0.038	0.041	0.049
Ba	0.67	0.67	2.3?	0.74	0.46
La					
Yb			0.0018		
Pb	0.17	0.12	0.028	0.078	0.12
Sp.G					
L.O.I.					
H ₂ O	20.4	19.2	15.5	17.4	18.6

Table 1 (Continued)

Station	Chub 17	Chub 19	Chub 34	Chub 39	Cusp 8P
Latitude	N 8-05	N 7-41	N 8-01	N 8-09	N 43-58
Longitude	W 125-25	W 125-37	W 126-58	W 125-20	W 140-38
Depth (m)	4453	4416	4440	4360	4350
Assoc Sed Sampler	Rad. O.	Rad. O.	Br. Clay	Rad. O.	Br. Mud
Nod. Size (cm)	-	Core	Core	-	Core
Anal. Ref.	M-116	M-61	ASL-60	M-115	M-2
Be					
B			0.010		
Na			2.1		
Mg			2.0		
Al	2.8	4.6	2.9	2.2	3.7
Si	6.1	14.3	7.5	5.8	11.8
P					
K	0.58	2.05	0.6	0.72	0.54
Ca	1.25	0.72	1.4	1.51	1.73
Sc					
Ti	0.20	0.18	0.2	0.18	0.55
V			0.06		
Cr					
Mn	26.2	9.3	34.1	28.1	17.7
Fe	6.7	9.2	5.3	6.3	9.4
Co	0.17	0.09	0.18	0.18	0.23
Ni	1.19	0.40	1.8	1.16	0.72
Cu	1.59	0.55	1.6	1.36	0.42
Zn	0.17	0.093		0.15	0.091
Ga					
Sr	0.073	0.055	0.09	0.067	0.091
Y			0.008		
Zr			0.036		
Mo	0.042	0.043	0.08	0.047	0.036
Ba	0.42	0.18	0.21	0.45	0.43
La					
Yb			0.0018		
Fb	0.053	0.08	0.027	0.058	0.13
Sp.G					
L.O.I.					
H ₂ O	19.2	16.5	22.	19.0	18.5

Table 1 (Continued)

22

Station	DWBD-1				DWBD-2	
Latitude	N 21-27				N 10-26	
Longitude	W 126-43				W 130-38	
Depth (m)	4300				4890	
Assoc Sed Sampler Nod. Size (cm)	- Dredge 3.5				Rad. O. Dredge 2.4	
Anal. Ref.	ASL-2*	ASL-4	H-496*	M-24	ASL-1	M-45
Be			0.0003			
B	0.04	0.02	0.015		0.021	
Na	2.0	3.5	1.5		2.8	
Mg	1.3	1.6	1.5		1.7	
Al	2.3	6.3	0.7	1.9	2.6	3.3
Si	7.0	21.5	3.	18.8	7.5	7.3
P				0.22		0.052
K	0.7	2.8	1.5	0.90	0.7	0.86
Ca	1.8	0.61	3.	1.00	1.8	1.46
Sc	0.0016	0.0014			0.0009	0.41
Ti	1.1	0.40	1.5	0.58	0.37	
V	0.06	0.019	0.07		0.046	
Cr		0.0015	0.0015		0.0008	
Mn	24.6	7.0	Major	9.7	31.6	22.7
Fe	18.2	7.9	Major	11.5	5.9	7.6
Co	0.50	0.07	0.03	0.30	0.17	0.26
Ni	0.46	0.39	0.3	0.13	1.7	1.25
Cu	0.36	0.28	0.3	0.19	1.4	1.21
Zn			0.05	0.043	0.05	0.11
Ga	0.0007	0.0007			0.0015	
Sr	0.09	0.042	0.15	0.066	0.053	0.073
Y	0.017	0.0063	0.015		0.0086	
Zr	0.10	0.038	0.15		0.038	
Mo	0.061	0.010	0.03	0.028	0.09	0.059
Ba	0.16	0.07	0.15	0.42	0.33	0.59
La	0.024		0.07			
Yb	0.0044	0.0009	0.0015		0.0026	
Pb	0.15	0.047	0.15	0.12	0.044	0.075
Sp. G						
L.O.I.	32.5	18.5			31.5	
H ₂ O				12.5		19.0

*See also Table 2, page 37

Table 1 (Continued)

Station	DWBD-4	DWBD-5	DWBD-7	DWBG-16
Latitude	S 17	S 16-10	S 46-44	S 6-05
Longitude	W 146	W 146	W 123-10	W 132-53
Depth (m)	1700	1190	4100	4855
Assoc Sed	Cor. Deb.	Cor. Deb.	-	Rad. O.
Sampler	Dredge	Dredge	Dredge	Core
Nod. Size (cm)	2.5x4x7	-	1.2	0.5-1.0
Anal. Ref.	ASL-32* M-75	ASL-29	ASL-36 M-101	ASL-57
Be				
B	0.06	0.05	0.019	0.06
Na	2.7	1.3	2.4	3.0
Mg	2.4	2.1	1.9	2.2
Al	1.2	0.4	5.0	4.0
Si	1.3	0.7	19.6	20.1
P		0.122		0.080
K	0.3	0.34	0.7	2.8
Ca	3.6	3.14	24.0	1.47
Sc	0.0010		0.0013	0.0016
Ti	1.5	1.11	0.8	1.2
V	0.10		0.039	0.025
Cr	0.0008		0.0013	0.0043
Mn	27.8	23.2	9.5	7.6
Fe	18.2	12.6	7.0	16.2
Co	2.3	1.53	0.46	9.6
Ni	0.8	0.58	0.30	0.23
Cu	0.10	0.95	0.078	0.29
Zn	0.06	0.062		0.86
Ga			0.0007	0.0007
Sr	0.14	0.15	0.13	0.062
Y	0.045		0.060	0.034
Zr	0.065		0.027	0.003
Mo	0.064	0.050	0.011	0.044
Ba	0.12	0.66	0.023?	0.005
La	0.021		0.011	0.036
Yb	0.0057		0.0053	0.009
Pb	0.40	0.28	0.13	0.30
Sp.G			0.06	0.46
L.O.I.	35.0	35.	13.5	0.081
H ₂ O		24.5		17.
			16.5	

*See also Table 2, page 37

MCC 15995009

24

Table 1 (Continued)

Station	DWBG-17		DWBG-19		DWBG-37	
Latitude	S 12-51		S 14-59		S 29-09	
Longitude	W 135-13		W 136-02		W 143-01	
Depth (m)	4318		4465		4120	
Assoc Sed	Choc. Clay		Red Clay		Red Clay	
Sampler	Core		Core		Core	
Nod. Size (cm)	0.5		0.5-1.0		2.5x4x4	
Anal. Ref.	ASL-44	M-81	ASL-22	M-80	ASL-39	M-87
Be						
B	0.019		0.022		0.03	
Na	2.7		3.0		2.2	
Mg	2.0		1.7		1.3	
Al	3.0	2.3	3.8	7.3	2.8	2.0
Si	6.1	4.7	13.5	14.2	7.5	5.4
P						
K	0.5	0.4	1.7	1.95	0.7	0.5
Ca	2.1	1.6	1.4	0.90	4.4	3.1
Sc					0.0017	
Ti	0.40	0.3	0.55	0.64	0.9	0.63
V	0.041		0.043		0.06	
Cr	0.001		0.0025		0.0013	
Mn	31.	23.9	15.2	12.0	17.7	12.7
Fe	9.1	7.0	14.7	9.8	21.7	15.5
Co	0.11	0.85	0.14	0.12	0.36	0.26
Ni	1.9	1.46	0.9	0.77	0.46	0.33
Cu	1.2	0.92	0.44	0.53	0.22	0.16
Zn	0.06	0.046		0.83		
Ga						
Sr	0.042	0.032	0.034	0.040	0.09	0.06
Y	0.010		0.007		0.028	
Zr	0.36		0.041		0.09	
Mo	0.039	0.03	0.030	0.018	0.033	0.024
Ba	0.25	0.19	0.12	0.22	0.11	0.08
La						
Yb	0.0018		0.0018		0.004	
Pb	0.036	0.028	0.018	0.038	0.11	0.08
Sp.G						
L.O.I.	23.	23.	22.	22. 14.2	28.5	28.5
H ₂ O						

Table 1 (Continued)

25

Station	DWBG-40	DWBG-43	DWBG-48				
Latitude	S 31-13	S 34-01					
Longitude	W 141-12	W 138-55	S 37-05				
Depth (m)	4280	4721	W 137-00				
Assoc Sed Sampler Nod. Size (cm)	Calc.O. Core -	Red Clay Core 0.5x2x2	Red Clay Core 0.7-2.0				
Anal. Ref.	ASL-42	M-90	ASL-43	M-91	ASL-66	ASL-67	M-93
Be							
B	0.04		0.04		0.012	0.029	
Na	1.5		2.4		2.7	2.5	
Mg	1.2		1.2		2.2	1.6	
Al	2.1	1.4	2.9	2.9	3.5	2.9	
Si	4.7	3.2	7.5	7.6	7.5	7.0	2.5 5.4
P							
K							
Ca	2.2	1.5	0.3	0.3	0.5	0.4	0.36
Sc	0.0014		2.2	2.2	1.5	2.5	1.1
Ti	1.3	0.9	0.0022		0.0013		
V	0.07		1.4	1.4	0.7	0.7	0.5
Cr			0.06		0.048	0.052	
Mn	20.9	14.3	19.6	19.6	26.5	24.6	19.0
Fe	26.6	18.2	21.7	21.7	11.2	15.4	8.0
Co	0.42	0.29	0.45	0.45	0.28	0.33	0.2
Ni	0.35	0.24	0.50	0.50	1.5	0.9	1.1
Cu	0.17	0.12	0.21	0.21	0.66	0.53	0.47
Zn			0.04	0.04		0.05	
Ga							
Sr	0.14	0.10	0.10	0.10	0.09	0.08	0.06
Y	0.026		0.031		0.013	0.013	
Zr	0.09		0.11		0.071	0.057	
Mo	0.051	0.035	0.036	0.087	0.09	0.042	0.064
Ba	0.18	0.12	0.13	0.13	0.15	0.27	0.11
La	0.015		0.016			0.011	
Yb	0.0044		0.0048		0.0031	0.0031	
Pb	0.10	0.069	0.11	0.11	0.089	0.14	0.064
Sp.G							
L.O.I.	31.5	31.5	29.5	29.5	28.5	30.5	28.5
H ₂ O							

Table 1 (Continued)

Station	DWBG-52	DWBG-54	DWBG-55	DWBG-56
Latitude	S 40-36	S 41-24	S 41-32	S 42-16
Longitude	W 132-49	W 129-06	W 128-15	W 125-50
Depth (m)	5120	4880	4750	4560
Assoc Sed Sampler	-	R.C.	-	Br. Clay
Nod. Size (cm)	Core 3	Core 2-3	Core -	Core 0.5-1.5
Anal. Ref.	ASL-55*	ASL-41	M-100	ASL-37
Be				
B	0.03	0.028	0.03	0.016
Na	2.5	2.1	2.1	2.0
Mg	1.9	1.2	1.6	2.0
Al	3.2	3.0	3.3	2.0
Si	4.9	11.7	6.9	5.1
P				
K	0.7	0.7	0.62	0.6
Ca	1.4	1.8	1.51	2.0
Sc	0.0017	0.0011	0.0016	0.0008
Ti	0.8	0.9	1.04	0.53
V	0.06	0.044	0.051	0.06
Cr				
Mn	22.8	20.9	19.6	32.9
Fe	14.7	14.0	11.7	10.5
Co	0.38	0.36	0.39	0.36
Ni	1.3	1.1	0.80	1.4
Cu	0.69	0.42	0.37	0.54
Zn	0.04		0.083	0.04
Ga	0.0007			
Sr	0.071	0.076	0.10	0.10
Y	0.015	0.013	0.020	0.011
Zr	0.065	0.059	0.10	0.045
Mo	0.061	0.038	0.034	0.063
Ba	0.13	0.14	0.80	0.15
La	0.011			
Yb	0.0031	0.0026	0.009	0.0026
Pb	0.16	0.12	0.20	0.064
Sp.G				
L.O.I.	27.5	29.5	20.3	25.5
H ₂ O				29.5

*See also Table 2, page 37

Table 1 (Continued)

Station	DWBG-78		DWBG-147B		DWHD-15	
Latitude	S 44-08		N 1-27		S 15-23	
Longitude	W 100-58		W 116-13		W 136-18	
Depth (m)	4100		4000		4480	
Assoc Sed	Calc.O.		Calc.O.		Calc.O.	
Sampler	Core		Core		Dredge	
Nod. Size (cm)	1.3x2x2		1x1.5x1.5		0.6x3x3	
Anal. Ref.	ASL-63	M-103	ASL-61	M-63	ASL-31	M-79
Be						
B	0.03		0.04		0.014	
Na	1.9		2.8		2.2	
Mg	1.9		1.5		2.1	
Al	2.5	1.7	1.3	0.9	3.4	4.5
Si	6.1	4.1	5.1	3.5	9.0	7.4
P						0.223
K					0.7	1.44
Ca	2.2	1.5	2.6	1.8	1.4	1.39
Sc	0.0034		0.0024	0.3	0.001	
Ti	0.52	0.35	0.41		0.7	0.29
V	0.048		0.053		0.053	
Cr					0.0007	
Mn	29.1	19.5	27.2	18.8	19.6	20.3
Fe	14.7	9.9	18.2	12.6	18.2	8.1
Co	0.15	0.10	0.07	0.05	0.14	0.12
Ni	1.0	0.67	1.1	0.76	1.0	1.17
Cu	0.48	0.32	0.68	0.47	0.64	1.07
Zn	0.06	0.04	0.06	0.04	0.06	0.12
Ga	0.0007				0.007	
Sr	0.08	0.05	0.14	0.10	0.062	0.067
Y	0.0067		0.013		0.018	
Zr	0.072		0.12		0.09	
Mo	0.047	0.031	0.044	0.03	0.036	0.041
Ba	0.12	0.08	0.26	0.18	0.12	0.24
La						
Yb	0.0026		0.0044		0.0018	
Pb	0.071	0.048	0.065	0.045	0.039	0.060
Sp.G						
L.O.I.	33.	33.	31.	31.	22.5	22.5
H ₂ O					20.3	

Station	DWHD-16				DWHD-47		
Latitude	S 16-29				S 41-59		
Longitude	W 146-33				W 102-01		
Depth (m)	1270				4200		
Assoc Sed Sampler Nod. Size (cm)	Coral Debris Dredge 4.5				Calc. ooze Dredge 2.5		
Anal. Ref.	ASL-5*	ASL-6	ASL-88*	M-76	ASL-30	H-497*	M-102
Be							0.0002
B	0.04	0.03	0.03		0.026		0.007
Na	2.2	2.2	1.8		2.5		1.5
Mg	2.1	1.6	1.4		1.4		1.5
Al	1.3	0.7	1.1	0.7	2.8	1.5	3.0
Si	2.0	1.5	1.7	1.3	8.4	3.	5.1
P				0.171			0.097
K		0.4		0.32	0.6	1.5	0.67
Ca	2.6	3.1	3.0	2.92	1.6	3.	1.57
Sc					0.0008	0.0007	
Ti	1.4	1.5	1.3	1.18	0.48	0.3	0.37
V	0.07	0.10	0.08		0.049	0.07	
Cr						0.0007	
Mn	29.7	30.3	32.2	22.4	22.1	Major	24.5
Fe	17.5	18.9	17.5	13.8	18.2	Major	9.6
Co	1.4	1.6	1.4	1.10	0.11	0.15	0.13
Ni	0.77	0.64	0.72	0.58	0.9	0.7	1.02
Cu	0.14	0.12	0.12	0.17	0.4	0.3	0.59
Zn	0.04		0.05	0.067	0.04	0.07	0.12
Ga					0.0007		
Sr	0.15	0.14	0.17	0.16	0.10	0.15	0.089
Y	0.034	0.026	0.024		0.017	0.015	
Zr	0.08	0.072	0.062		0.07	0.07	
Mo	0.042	0.07	0.057	0.056	0.037	0.03	0.054
Ba	0.12	0.16	0.19	0.51	0.10	0.15	0.38
La	0.016	0.016	0.012			0.03	
Yb	0.0048	0.0053	0.0031		0.0026	0.0015	
Pb	0.31	0.20	0.19	0.25	0.071	0.07	0.065
Sp.G							
L.O.I.	36.	36.	35.	36.	30.		
H ₂ O				27.5			19.3

*See also Table 2, page 37

Table 1 (Continued)

Station	DWHD-55		DWHD-72		DWHG-34		DWHH-4
Latitude	S 37-04		S 25-31		S 44-13		N 24-22
Longitude	W 81-50		W 85-14		W 127-20		W 125-00
Depth (m)	4000		920		4600		4330
Assoc Sed	Calc.O.		Coral Deb.		Calc.O.		Br. Clay
Sampler	Dredge		Dredge		Core		Core
Nod. Size	2-3		2-3		0.5-2.5		0.8x2x2
Anal. Ref.	ASL-48	M-98	ASL-23	M-89	ASL-68		ASL-62
							M-28
Be							
B	0.027		0.023		0.023		0.025
Na	2.7		2.4		3.0		2.2
Mg	2.0		2.1		1.1		2.1
Al	3.9	2.8	0.7	0.7	4.4	2.8	2.0
Si	8.4	6.2	2.6	0.33	16.3	7.9	5.7
P				0.430			
K	0.4	0.3	0.5	1.20	0.8	0.5	0.34
Ca	1.7	1.2	2.1	1.73	1.8	1.8	1.3
Sc			0.001			0.0027	
Ti	0.31	0.22	0.59	0.21	0.7	0.7	0.5
V	0.048		0.06		0.024	0.052	
Cr	0.0008					0.0008	
Mn	26.5	19.1	37.3	42.3	15.2	25.9	18.5
Fe	9.8	7.1	11.2	2.47	11.2	13.3	9.5
Co	0.11	0.08	0.7	0.17	0.20	0.33	0.24
Ni	1.6	1.2	0.56	0.26	0.45	1.7	1.21
Cu	0.72	0.52	0.16	0.15	0.24	0.69	0.49
Zn	0.04	0.03	0.04	0.052	0.04	0.04	0.03
Ga							
Sr	0.051	0.037	0.074	0.090	0.058	0.079	0.056
Y	0.013		0.026		0.011	0.015	
Zr	0.038		0.026		0.056	0.08	
Mo	0.064	0.046	0.060	0.043	0.011	0.055	0.039
Ba	0.09	0.065	0.18	0.79	0.079	0.25	0.18
La			0.014			0.011	
Yb	0.0035		0.0057		0.0026	0.0031	
Pb	0.052	0.037	0.19	0.062	0.10	0.071	0.051
Sp.G							
L.O.I.	28.	28.	26.		25.5	28.5	28.5
H ₂ O				12.8			

MCC1895009

30

60

Table 1 (Continued)

Station	DWHH-92	Hend 1	MP-25F2	MP-26A3	MP-32	MP-33K
Latitude	N 9-59	N 23-30	N-19-07	N 19-03	N 18-20	N 17-48
Longitude	W 118-00	W 119-35	W 169-44	W 171-00	W173-23	W174-22
Depth (m)	4295	440	1740	1372	3860	1810-2290
Assoc Sed Sampler	R.C.	Vol.Rock	Vol.Rock	Vol. Rock	R.C.	Coral Deb
Nod. Size (cm)	Core	Dredge	Dredge	Dredge	Dredge	Dredge
	1.5x1.5x2	-	3x2x2	3x3x3	Crust	1 cm Cst.
Anal. Ref.	ASL-64	M-110	M-40	M-39	M-38	M-37
Be						
B	0.015					
Na	2.5					
Mg	1.9					
Al	3.7	0.7	1.0	1.0	2.3	1.8
Si	9.8	1.2	3.3	2.7	7.1	4.9
P			0.031	0.074		0.082
K	1.0	0.3	0.40	0.38	0.52	0.39
Ca	1.5	2.1	2.07	2.24	1.51	6.85
Sc						
Ti	0.5	0.35	1.13	1.13	1.10	0.89
V	0.039					
Cr						
Mn	24.6	20.5	20.5	22.7	13.1	14.4
Fe	11.2	13.5	14.5	13.3	14.6	14.05
Co	0.09	0.62	0.95	0.95	0.42	0.70
Ni	1.0	0.36	0.42	0.60	0.30	0.29
Cu	0.74	0.045	0.10	0.15	0.17	0.072
Zn			0.062	0.062	0.043	0.04
Ga						
Sr	0.07	0.076	0.15	0.14	0.12	0.14
Y	0.013					
Zr	0.08					
Mo	0.055	0.10	0.060	0.071	0.027	0.043
Ba	0.14	0.076	0.50	0.58	0.61	0.43
La						
Yb	0.0018					
Pb	0.02	0.10	0.24	0.23	0.22	0.20
Sp.G						
L.O.I.	25.	31.	28.2	23.9	25.2	19.4
H ₂ O						

MAY 9 1969

31

Table 1 (Continued)

Station	MP-5	MP-37A	MP-43D	Msn-139D	Msn-G	Msn-J
Latitude	N 14-22	N 17-04	N 11-57	S 0-45	N 14-11	N 7-47
Longitude	W 133-07	W 177-15	E 164-59	W 147-36	W 161-08	W 168-00
Depth (m)	-	2010-1830	1500-2100	3340	5652	4994
Assoc Sed	R.C.	Coral D.	-	Calc.O.	R.C.	R.C.
Sampler	-	Dredge	Dredge	Dredge	Corer	Core
Nod. Size (cm)	0.5	2cm Ost	5cm Cst.	1-5	½x1x3	2x2½x2½
Anal. Ref.	M-44	M-36	M-35	M-59	M-41	M-58
Be						
B						
Na						
Mg						
Al	2.9	2.2	0.5	0.7	3.2	1.7
Si	7.0	4.1	1.7	3.5	5.6	4.4
P		0.138				
K	0.77	0.43	0.2	0.35	0.64	0.41
Ca	1.36	8.48	1.6	1.98	1.49	1.73
Sc						
Ti	0.09	1.00	1.1	1.01	0.75	1.23
V						
Cr						
Mn	22.9	13.0	19.5	18.6	23.3	20.2
Fe	9.2	10.7	11.5	17.3	9.2	13.8
Co	0.45	0.45	1.05	0.44	0.31	0.39
Ni	1.05	0.47	0.42	0.32	0.98	0.60
Cu	0.78	0.19	0.11	0.11	0.81	0.43
Zn	0.11	0.057		0.060	0.11	0.069
Ga						
Sr	0.079	0.17	0.11	0.14	0.080	0.12
Y						
Zr						
Mo	0.037	0.049	0.039	0.054	0.053	0.042
Ba	0.51	0.56	0.15	0.49	0.46	0.59
La						
Yb						
Pb	0.12	0.19	0.15	0.12	0.085	0.11
Sp.G						
L.O.I.			34.5			
H ₂ O	19.3	22.5		28.0	18.4	24.3

MCCARTHY 3009

32

Table 1 (Continued)

Station	Msn-K	Msn-Q	Msn-S	N.H.C-10	PAS-19121	SOB-5
Latitude	N 6-03	S 7-03	S 9-00	N 40-14	N 27-20	N 31-19
Longitude	W 170-00	E 174-12	E 171-28	W 155-06	W 116-10	W 117-38
Depth (m)	5400	5378	5000	5500	4030	2110
Assoc Sed	R.C.	R.C.	R.C.	R.C.	-	T.Sed.
Sampler	Core	Core	Dredge	Core	Wire	Dredge
Nod. Size	1½x1½	1.5	½-4	61x61x32	½x2x2	Crust
Anal. Ref.	M-57	M-66	M-65	M-1	M-30	M-14
Be						
B						
Na						
Mg						
Al	3.0	4.0	4.1	6.3	2.4	3.9
Si	5.2	6.5	7.3	13.9	6.2	12.5
P				-(3)		
K	0.54	0.42	0.52	1.71	0.7	0.92
Ca	1.46	1.45	1.84	1.00	1.0	0.94
Sc						
Ti	0.25	1.02	0.42	0.63	0.6	0.25
V						
Cr						
Mn	29.0	15.7	19.5	11.9	21.2	13.4
Fe	5.25	15.5	11.1	6.9	9.3	11.4
Co	0.16	0.26	0.13	0.23	0.27	0.083
Ni	1.54	0.45	0.63	0.45	1.25	0.34
Cu	1.90	0.45	0.71	0.47	0.70	0.061
Zn	0.16	0.060	0.12	0.057	0.04	0.067
Ga						
Sr	0.057	0.10	0.083	0.077	0.051	0.074
Y						
Zr						
Mo	0.052	0.037	0.021	0.038	0.048	0.036
Ba	0.23	0.41	0.22	0.57	0.20	0.41
La						
Yb						
Pb	0.053	0.13	0.080	0.20	0.65	0.075
Sp.G						
L.O.I.						
H ₂ O	17.7	21.8	19.4	19.3	22.	15.4

4-CC159 25009

Table 1 (Continued)

33

Station	SOB-10	SOB-13	SOB-22	SOB-20	SOB-25	SOB-27
Latitude	N 30-12	N 29-30.5	N 31-21	N 31-23	N 31-15	N30-17.5
Longitude	W 117-38	W117-17	W119-03	W 118-03	W118-37	W117-40
Depth (m)	1300	820-540	915	1040	1650-1830	1060
Assoc Sed	T. Sed.	T.Sed.	T.Sed.	T.Sed.	T.Sed.	T.Sed.
Sampler	Dredge	Dredge	Dredge	Dredge	Dredge	Dredge
Nod. Size	Crust	1/60	Crust	Crust	1.2/20	3/30
Anal. Ref.	M-15	M-111	M-11	M-13	M-112	M-114
Be						
B						
Na						
Mg						
Al	3.5	0.6	6.0	2.7	2.8	3.9
Si	11.8	1.1	12.4	9.8	12.0	15.6
P						
K	0.55	0.29	1.14	0.42	0.45	1.08
Ca	1.48	2.14	0.71	1.65	1.55	1.01
Sc						
Ti	0.53	0.47	0.34	0.63	0.48	0.43
V						
Cr						
Mn	10.7	21.1	11.7	13.7	11.8	7.8
Fe	14.7	15.6	10.3	14.5	16.4	12.3
Co	0.40	0.73	0.19	0.53	0.26	0.23
Ni	0.18	0.22	0.24	0.23	0.13	0.24
Cu	0.035	0.043	0.06	0.052	0.044	0.078
Zn	0.036	0.021	0.048	0.040	0.055	0.057
Ga						
Sr	0.13	0.18	0.055	0.15	0.13	0.072
Y						
Zr						
Mo	0.41	0.093	0.036	0.048	0.036	0.036
Ba	0.46	0.88	0.47	0.61	0.45	0.33
La						
Yb						
Pb	0.24	0.27	0.091	0.21	0.20	0.16
Sp.G.						
L.O.I.						
H ₂ O	19.0	20.1	9.9	20.6	21.2	10.9

ACC 139 5009

34

Table 1 (Continued)

80

Station	SW-48	Trans-14C	Trans 14-D	UNK-BH2	UNK-MS	UNK-RR
Latitude	N 11-25	N 19-46	N 19-20	N13-37	N22-30	N 19-49
Longitude	W113-48	W114-44	W114-12	W126-27	W113-08	W121-44
Depth (m)	4085	3438	3480	5150	3604	4320
Assoc Sed Sampler	R.C.	R.C.	R.C.	R.C.	R.C.	R.C.
Nod. Size (cm)	Core	Core	Core	Tele Cab.	Dredge	Dredge
	-	1x3x2	3x3x1	90x90x120	5x3x3	1-1½
Anal. Ref.	M-54	M-52	M-53	M-34	M-31	M-51
Be						
B						
Na						
Mg						
Al	1.9	2.5	2.6	3.0	3.9	3.7
Si	4.2	5.9	6.1	6.5	7.9	7.9
P				0.164		0.089
K	0.48	0.60	0.65	0.38	0.95	1.04
Ca	1.79	1.50	1.44	1.37	1.28	1.27
Sc						
Ti	0.66	0.48	0.36	0.87	0.16	0.59
V						
Cr						
Mn	23.2	21.2	22.6	14.9	28.8	21.4
Fe	11.5	12.0	10.2	18.40	4.85	9.6
Co	0.21	0.22	0.23	0.29	0.26	0.36
Ni	1.01	0.93	1.09	0.22	0.63	1.09
Cu	0.66	0.61	0.71	0.17	0.42	0.76
Zn	0.086	0.083	0.11	0.048	0.026	0.086
Ga						
Sr	0.11	0.10	0.084	0.11	0.062	0.092
Y						
Zr						
Mo	0.061	0.047	0.041	0.037	0.065	0.046
Ba	0.56	0.46	0.61	0.58	0.43	0.57
La						
Yb						
Pb	0.12	0.098	0.053	0.18	0.022	0.12
Sp.G						
L.O.I						
H ₂ O	23.2	20.5	20.4	21.4	17.3	20.3

R.D. & S. 5009

35

Table 1 (Continued)

Station	Vit-4191	Vit-4199	Vit-4217	Vit-4221	VS-BII-35	VS-78
Latitude	N 40-20	N 35-07	N 29-57	N 29-58	N 22-18	N 29-03
Longitude	W135-47	W137-53	W120-42	W125-55	W107-48	W113-33
Depth (m)	4560	5035	4017	4325	3000	384-493
Assoc Sed	R.C.	R.C.	R.C.	R.C.	T.Sed.	T.Sed.
Sampler	-	-	Trawl	-	Trawl	Dredge
Nod. Size (cm)	3	3-9	4x2x2	2x1½x1½	5x2x1	8x6x5
Anal. Ref.	M-3	M-10	M-29	M-26	M-33	M-32
Be						
B						
Na						
Mg						
Al	4.3	4.9	4.2	7.9	4.3	1.9
Si	13.3	13.4	10.1	16.8	13.4	4.1
P						
K	0.73	1.16	0.83	2.41	1.52	0.96
Ca	1.43	1.14	1.34	0.74	0.87	1.16
Sc						
Ti	0.49	0.65	0.49	0.32	0.08	0.07
V						
Cr						
Mn	16.5	10.4	16.7	8.3	24.8	38.9
Fe	9.5	13.0	11.2	7.0	1.36	0.86
Co	0.22	0.29	0.15	0.15	0.017	0.010
Ni	0.58	0.33	0.74	0.41	0.12	0.045
Cu	0.36	0.29	0.45	0.25	0.046	0.010
Zn	0.076	0.062	0.069	0.067	0.043	0.023
Ga						
Sr	0.070	0.076	0.063	0.065	0.039	0.10
Y						
Zr						
Mo	0.026	0.017	0.042	0.011	0.032	0.022
Ba	0.36	0.49	0.59	0.24	0.33	0.37
La						
Yb						
Pb	0.13	0.19	0.12	0.16	0.046	0.025
Sp.G.						
L.O.I.						
H ₂ O	19.2	14.6	18.9	15.3	11.0	13.0

MAY 15 1960 009

36

Table 1 (Continued)

71

Station	Wig-3	Wig-5	Wig-7	Wig-6	Wig-3	Wig-5	Wig-6
Latitude				N28-58.7			
Longitude				W125-40.5			
Depth (m)				4000			
Assoc. Sed.	R.C.	R.C.	R.C.	R.C.	R.C.	R.C.	R.C.
Sampler							
Nod. Size (cm)	0.5	0.4	0.5	0.6	0.5	0.5	0.4
Depth in core (cm)	0 - 2	2 - 4	4 - 6	6 - 8	12 - 14	14-16	30-32
Anal. Ref.	M-122	M-123	M-124	M-125	M-126	M-127	M-128
Be							
B							
Na							
Mg							
Al	3.5	4.6	2.6	2.7	3.9	7.8	5.0
Si	8.7	13.0	7.1	7.3	12.1	18.0	13.4
P							
K	0.90	1.55	0.69	0.64	1.20	2.79	0.93
Ca	1.11	0.65	1.26	1.25	0.60	0.41	2.81
Sc							
Ti	1.20	0.54	1.28	1.12	2.66	0.82	1.60
V							
Cr							
Mn	14.3	9.9	16.7	15.6	5.2	4.3	5.9
Fe	13.6	12.1	13.4	14.5	15.3	7.7	12.2
Co	0.37	0.28	0.39	0.45	0.31	0.16	0.14
Ni	0.51	0.64	0.59	0.57	0.087	0.16	0.30
Cu	0.34	0.42	0.38	0.29	0.16	0.17	0.23
Zn	0.081	0.072	0.072	0.069	0.043	0.031	0.060
Ga							
Sr	0.079	0.056	0.10	0.10	0.066	0.052	0.058
Y							
Zr							
Mo	0.036	0.044	0.045	0.034	0.043	0.037	0.056
Ba							
La	0.57	0.31	0.69	0.87	0.52	0.19	0.21
Yb							
Pb	0.18	0.14	0.18	0.21	0.18	0.17	0.14
Sp.G							
LOI							
H ₂ O	20.8	18.9	20.9	21.6	21.8	17.3	15.8

Table 2

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37

A7

Station	Alb 13	Alb 31	Alb 173	Alb 4662	Alb 4685	Alb 4721
Anal. Ref.	H-493	ASL-52	H-49	H-495	ASL-9	ASL-10
Nb	0.003		0.015	0.007		
Ag		0.0004			0.0002	0.0006
Ce	0.07		0.15	0.03		
Nd	0.03		0.03	0.015		
Tl	0.015		0.015	0.015		
Bi	d		d			
Ra						
Th						
U						

Station	Chal 285	Chin 16	DWBD-1		DWBD 4	DWBG 52
Anal. Ref.	M&R p 422	ASL-56	ASL-2	H-496	ASL-32	ASL-55
Nb				0.015		
Ag			0.0002			
Ce				0.3		
Nd				0.07		
Tl				0.015		
Bi	0.029	0.0027		0.003	0.0036	0.0027
Ra						
Th						
U						

Station	DWHD 16		DWHD 47
Anal. Ref.	ASL-5	ASL-88	H-497
Nb			0.007
Ag			0.07
Ce			
Nd			0.03
Tl			0.015
Bi	0.0027	0.0036	
Ra			
Th			
U			